
**AC 2012-3457: ON THE FENCE: THE INFLUENCE OF PROTG-MENTOR
RELATIONSHIPS ON WOMEN DOCTORAL STUDENTS' ACADEMIC
CAREER ASPIRATIONS IN ENGINEERING**

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Statement of Purpose

According to a 2004 report from the Commission on Professionals in Science and Technology, women in engineering and the physical, mathematical, and environmental sciences make up less than 6 percent of full professor positions.¹ Two decades ago, researchers projected that occupational equity for females in science and engineering was just “a matter of time”—time for increasing the number of female Ph.D. students and moving them through the ranks of academia.² However, the prediction that growing numbers of female Ph.D. students would lead to greater gender equity among the professoriate has not come to pass.

Fox studied women doctoral students' experiences in science and engineering, surveying over 3,000 women, finding that women are less likely to be “taken seriously” by their advisers, feel less comfortable speaking in research groups, and are less likely to receive effective help and feedback from their professors.³ Her work suggests that greater attention should be paid to understanding the experiences of women graduate students in science and engineering, with a particular focus on their interaction with faculty members. Although a wide range of higher education literature emphasizes the importance of student-faculty interaction on students' satisfaction and professional development.⁴ The research on female graduate students and their interactions with faculty in science and engineering is fairly limited.

Accordingly, the objective of this project is to examine the protégé-mentor relationships among women doctoral students and their faculty members in the field of engineering. More specifically, I examine how protégé-mentor relationships support or limit women's aspirations to pursue academic careers. To pursue these issues, I conducted thirty in-depth semi-structured interviews with female doctoral students in the School of Engineering at Western University—a pseudonym for a large research university in the western United States. This university was selected due to its strong engineering programs with sizeable graduate enrollments. Theoretically speaking, I utilized theories related to mentoring and organizational socialization, combined with Feminist Standpoint Theory, to guide my study throughout its duration. The specific research questions are:

- 1) In what ways do protégé-mentor relationships influence the socialization experiences of women doctoral students in engineering?
- 2) How do protégé-mentor relationships impact women doctoral students' aspirations to pursue academic careers?

Theoretical Perspective

The theory framing this study is grounded in three bodies of work: literature on women's experiences in science and engineering, research on organizational and graduate student socialization, and work on Feminist Standpoint Theory.

Initially, I conducted an extensive review of previous research on women's interactions with faculty in science and engineering graduate programs. I examined this body of literature in order to better understand women's overall experiences in graduate school, their career

aspirations, and their interaction with faculty members.⁵

The second area that informs my framework is organizational socialization, specifically graduate student socialization. Work in the area of socialization is important to consider when one examines women doctoral students' experiences interacting with their professors. Van Maanen was one of the first to develop organizational socialization as a theoretical frame of reference.⁶ He noted that socialization is a continuing process through which an individual learns the norms, beliefs, values and behaviors in order to adapt to an organization. In the context of graduate education, the experience may be considered as the anticipatory socialization period for entry into their professional field.⁷ Additionally, graduate student socialization is often examined as a means of better understanding one's introduction to the academic career.⁸

A third theoretical perspective guiding this study is Feminist Standpoint Theory. This theory emphasizes analyzing women's lives by placing great emphasis on their lived experiences and developing a deeper understanding of how they define their social worlds.⁹ Harding noted that Standpoint Theory "provides guidelines for future research" through offering "empowerment" to the historically oppressed groups (women) in the androcentric institutional power and production of knowledge (p. 45). She further suggested the advantage of using Feminist Standpoint Theory is "to create oppressed peoples as collective 'subjects' of research rather than only as objects of others' observation, naming, and management" (p. 3). Using Feminist Standpoint Theory enables this study to analyze this group of women doctoral students' graduate school interactions with their mentors from a framework that centers these women's daily lives and experiences. Combining Feminist Standpoint Theory with analysis of women's experiences in engineering and science and theories and research on socialization offers a solid theoretical foundation for exploring the intertwined relationship between women doctoral students and their experiences interacting with their professors in engineering.

Research Method

Data was collected with qualitative methods due to the highly exploratory nature of the study.¹⁰ Western University was selected as the research site for several reasons: the presence of strong graduate programs in engineering; engineering graduate students accounting for over 20 percent of the entire 10,000 graduate student population; and the School of Engineering's range of programs and departments, including bioengineering, chemical and biomolecular engineering, civil and environmental engineering, computer science, electrical engineering, materials science and engineering, and mechanical and aerospace engineering. Another important facet is the female to male ratio among Western's student population. In 2008, there were only 400 female engineering graduate students, while their male counterparts exceeded 1900. Additionally, of the over 200 faculty members in the School of Engineering, only 21 are female.

Data collection consisted of thirty semi-structured interviews with women doctoral students in engineering. All interviews were guided by a semi-structured interview protocol. The interviews were each approximately one hour long, digitally recorded, and transcribed verbatim. Prior to the interview, subjects filled out short questionnaires, which asked for basic demographic and background information. Snowball sampling techniques were used due to the low visibility and representation of women doctoral students in most engineering departments. At the end, all interview participants are affiliated with four different departments:

bioengineering, civil and environmental engineering, chemical and biomolecular engineering, and mechanical and aerospace engineering. The participants were also selected based on their advanced standing in the doctoral program, second year or above.

In order to address the research questions effectively, as well as potentially broaden the findings of the study, both deductive and inductive data analysis methods were used.¹¹ In order to answer key research questions, a deductive method was used to analyze findings based on an initial coding of the transcripts. But more inductive approaches are useful when researchers want to uncover additional, unanticipated findings. This approach allowed me to go beyond theory-driven themes and explore additional categories emerging from the data.

Findings

As indicated by the research questions, protégé-mentor relationships and their influences on women doctoral students' aspirations to pursue academic careers is the primary concern of this study. The findings emerging from the interview data are illustrated in the following key themes:

Fear of balancing academic career and family

One of the major obstacles addressed by nearly all participants is the perceived challenge of balancing academic careers and their future family obligations. Women doctoral students' observations reveal two major reasons for them to shy away from pursuing academic careers: 1) the demanding lifestyles that they perceive male faculty members to have; and 2) the lack of advice and examples from female mentors. Women doctoral students perceived male faculty mentors as overly focused on issues related to research and developing research papers, while rarely discussing family life and marriage. Given the small representation of female faculty in engineering at Western, a small group of professors appeared to assume the role of "life mentor" to many of the students in the study. These doctoral students describe the advice concerning personal life as "very inspiring and helpful," "encouraging in the sense that I know I can actually have a life outside of the research lab," and even "very calming and therapeutic." Women doctoral students who receive advice and feedback on their concerns about the balance between their academic and personal life express high interest in pursuing academic careers. Nina, a fourth year Ph.D. student studying chemical engineering, shares her experiences that represent a majority of the research participants' views:

I know it must be very difficult for female professors and that's probably why we have very few. They are mothers and they need to take care of their families. But [my faculty adviser] did it! She has children but she handles it really well. She has both [a] career and a happy family. So I want to do the same thing! It's a very good example for us [women doctoral students]. I see that females can also be good engineering professors. It really helps you to see your future. I keep telling myself "If this woman can do it, I can do it too!"

Exposure to stressful and demanding engineering environment

All women doctoral students suggested that male advisers tend to create "intense and stressful" lab environments. Also, nearly all of the participants discussed direct or indirect experiences concerning "extra challenges and burdens." This was especially true for women

international doctoral students. These extra challenges were seen to be connected to negative mentoring experiences with male faculty members. Thirty percent of the women discussed their “disturbing” mentoring experience as foreign nationals. Many domestic students also report this phenomenon. Jennifer, a second year domestic student in environmental engineering, points out:

I feel that some advisers sometimes use visa sponsoring as a way to threaten [international students]. It definitely happens! One of my friends... she’s an international student and her adviser told her that if she doesn't work hard enough, she'd be put on probation... I know she works a lot and she doesn't even go home for Christmas! Her adviser already put another international student on probation.

The majority of the women doctoral students maintained that, compared to the “demanding” mentoring approach of some male professors, women advisers often employed more personal and less stressful ways of mentoring. This group of mentors was more likely to incorporate various kinds of information into the advising relationship other than “demanding results” or “setting deadlines.” Half of the women stated that they tend to work more efficiently under women mentors because they have a “less stressful” way of advising.

Exclusion from informal professional networks and social settings

All the women doctoral students expressed concerns regarding their disadvantages in a male-dominated engineering field. Ten interview participants described the informal socialization experience as “unwelcoming,” “discouraging,” and even “exclusive.” Anne, a second year environmental engineering doctoral student, discusses her experience of attending a social at a professional conference:

It was like the whole “old boys’ club” thing. It was my first time to attend this conference last year and I’ve heard they had socials in the evening. My adviser told me it was really important to attend the socials. So I went. But all I saw was groups of male professors... I couldn’t really integrate myself into that group! I couldn’t just walk [up] to them and say, “Hey guys! What’s up?” I can definitely feel the intimidation as a young female professor getting into that circle or even as a social group... to meet and network with this large group of old male professors.

Interview participants also pointed out that male students usually had “the privilege” to socialize with their professors outside of the laboratory setting, while their female counterparts were omitted from many non-academic related social events, such as sporting events, conference socials, and barbecues. Such experiences seemed to cause doubt and concern among women doctoral students about their future career choices. Some women who had previous internship experience in the private sector expressed their frustration by saying things such as, “I’d rather work in industry where I can have someone to talk to.” Other female doctoral students who worked in male professors’ labs reporting feeling frustrated over the fact that they are not included in informal social events.

Disparities in funding

Another factor that makes a tremendous difference in one’s doctoral study and its completion rate is funding.¹² Data from this study unveiled rather large funding disparities between female and male doctoral students. A common problem expressed in the interviews was that women

students needed to complete several research projects or grant proposals for their advisers without compensation before receiving continuous funding support. When asked about “funding opportunities and resources,” several doctoral students reported similar stories:

I need[ed] to work for free to prove myself and that definitely brought my confidence down a lot. I didn't feel like he respected my work just because I was working for free, and I'd have to [teach] and then do research and write proposals for him, and I just didn't feel like it was the right situation. And [more advanced women doctoral students] told me that, "Oh, yeah... you need to work for free here [in the lab] to prove yourself. If you don't, [your advisor will] continue not to pay you."

In addition, some women doctoral students described a “double standard” when it comes to funding opportunities between male and female students, with the males often getting the better funding packages while being less likely to work for free before receiving funding from their advisers. Challenges created by funding disparities directly contribute to degree progress and career choices of women doctoral students. Such difficulties are seen as a major obstacle to overcome and one woman even stated: “I have my master's degree already and I'm always keeping an eye on the job market. If I still don't get funding next quarter, I'll drop out [of the doctoral program] and start working [in industry].”

Disparities in the entrepreneurial/industry connections

In this study, the engineering departments revealed a high degree of involvement in the private sector. Many women doctoral students discussed their male advisers' engagement in industry and its impact on the mentoring relationship. When asked to describe their major ways of interacting with faculty advisers, their responses reflected the absence of mentoring outside of their primary research due to the fact that many faculty members are busy “advising some company in the private sector” or handling “their own engineering companies.” Such entrepreneurship was only reported of male professors, given that the few female professors in the School of Engineering are fairly “young” and are focusing their attention on “obtaining tenure.” In the meantime, the women doctoral students believe that their male peers are much more likely to work for industry and thus have greater opportunities to receive extra funding. For example, Molly, a fifth year bioengineering doctoral student, stressed:

He [a male student working in the same lab as Molly] does some work for [Molly's adviser's] company and then he also does all the research... I know another two guys in my lab also work for [the] company. They go there, get research projects and also get [an] extra stipend.

Furthermore, over a third of the women reported that they did not receive sufficient training and preparation for jobs in neither academia nor the private sector. Women doctoral students also believed that they were less likely to receive opportunities to work in industry through their advisers' connections.

Discussion/Conclusion

As Van Maanen argues, mentors play a key role in organizational socialization.¹³ At Western University, women doctoral students emphasized the specific importance of the presence of female faculty mentors. Additionally, they noted pressing issues concerning the fundamental differences between male and female mentors. Such variations consist of different mentoring approaches, range of mentoring topics discussed, and inclusion/exclusion to social

events and industry opportunities. For some participants, the gender of their advisers makes a tremendous impact on funding opportunities and types of training they received toward future career paths. Both international and domestic doctoral students pointed out the extra burden that international women doctoral students have to shoulder due to the nature of engineering study. Not only do international women face visa issues, but also their limited interactions with faculty members limit their professional opportunities. Consistent with Tierney and Rhoads' theory on the early stage of faculty socialization, mentoring problems tend to arise in various forms for underrepresented groups. Funding disparities appeared to be a rather serious issue for women doctoral students. This research suggests that improving organizational practices and policies in various areas concerning the advising relationship, funding, and non-academic issues, such as expanding counseling and social opportunities, would no doubt enhance the quality of women doctoral students' mentoring experiences. Such efforts may effectively assist graduate women in engineering to overcome academic, professional, and personal hardships and encourage them to pursue careers in academia. The increase and quality of female professors in academia may in turn benefit future women doctoral students in their mentoring and career training.

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